

REMARKS/ARGUMENTS

The present Amendment is responsive to the non-final Office Action mailed August 16, 2006, in the above-identified application.

Claims 1-6, 9, 13, 15-20, 25 and 26 are canceled without prejudice or disclaimer. New claims 29 and 30 are added so as more fully to claim patentable aspects of applicant's invention. Therefore, claims 7, 8, 10-12, 14, 21-24 and 27-30 are the claims currently pending in the present application.

Claims 7 and 11 are amended to clarify features recited thereby. Further, claims 10 and 14 are amended so that they depend from a claim currently pending in the present application.

Rejection of Claim 28 under 35 U.S.C. § 112, Second Paragraph

Claim 28 is rejected under 35 U.S.C. § 112, second paragraph on the ground that allegedly "droplets of said alkaline solution are injected" lacks antecedent basis.

Claim 28 refers to "said alkaline solution," which is referred to in the first element of claim 11, where it describes "a first step of supplying an alkaline solution to a surface of a substrate." Thus, the alkaline solution discussed in claim 28, is previously mentioned in claim 11. Accordingly, this rejection should now be withdrawn.

Rejection of Claims 7-10, 21, 22 and 27 under 35 U.S.C. § 103

Claims 7-10, 21, 22 and 27 are rejected under 35 U.S.C. § 103 as being obvious based on Okuda et al., U.S. Patent Application Publication No. 2002/0035762 in view of Aoki et al., U.S. Patent No. 5,635,053 as evidenced by Verhaverbeke, U.S. Patent No. 5,972,123, Tomita et al., U.S. Patent No. 6,431,185 and Skee, U.S. Patent No. 6,465,403. Reconsideration of this rejection is respectfully requested.

According to an aspect of applicant's invention a substrate processing method comprising three major operations is provided. The processing method includes a first step of supplying an alkaline solution to a surface of a substrate, a second step of supplying an acid solution to the surface of the substrate, and a third step of supplying an alkaline solution to the surface of the substrate after the second step. According to an aspect of the present invention, the alkaline

solution in the first step and the third step is supplied by injecting droplets which are formed by mixing the alkaline solution with gas. Accordingly, the process according to the present invention achieves an efficient removal of particle and metal contaminants from the surface.

By way of illustration, in the first step, as droplets of the alkaline solution are injected to the surface of the substrate, particles are removed from the surface as a result of the physical impact of the droplets. In the second step, since an acid solution is supplied to the surface of the substrate, metal contaminants adhering to the surface of the substrate dissolve and thus may be removed. Also, since the surface of the substrate may be slightly etched as a result of the second step, particles may come up to the surface of the substrate as a result of the etching, which can be removed in the third step in an efficient manner. According to an aspect of the invention, in the third step, as droplets of the alkaline solution are injected to the surface of the substrate, particle and metal contaminants that have come up to the surface are removed by the physical impact of the droplets. Thus, a novel method is provided according to an aspect of the invention by the three steps above-described. Therefore, according to an aspect of the present invention, the amount or degree of etching of the surface may be reduced or minimized.

Further, according to the recitations of claim 8, droplets are injected only in the first and third steps, thus avoiding excessive impact to the substrate. Figure 29 illustrates the results of an experiment incorporating the above-described processing method.

For at least the following reasons, the recitations of independent claim 7 are neither anticipated by nor obvious based on the cited art. By way of example, claim 7 requires a first step of supplying an alkaline solution to a surface of a substrate, a second step of supplying an acid solution to the surface of the substrate after the first step, and a third step of supplying the alkaline solution to the surface of the substrate after the second step, wherein the alkaline solution is a mixed solution containing ammonia water and hydrogen peroxide water.

Okuda discloses a substrate processing apparatus that generates a process liquid mist mixing liquid and pressurized gas which removes products from a substrate (Okuda, Abstract). Okuda does not disclose or suggest supplying an alkaline solution, an acid solution, and then an alkaline solution, in that order, to the surface of a substrate. The Office Action acknowledges that Okuda does not disclose two or three of these steps (Office Action, page 3: "Okuda does not

teach two or three steps of supplying various solutions to the surface of a substrate”). Therefore, Okuda does not disclose or suggest the substrate processing method claimed in claim 7.

Applicant notes that the present invention is not simply a repeated supply of alkaline solution and a supply of an acid solution, but should be thought of as a distinct combination of steps that is effective to remove contaminant effectively from a substrate surface. Okuda and the other references, even taken together in combination, do not disclose or suggest the combination of operations claimed in claim 7. Therefore, it is respectfully submitted that the recitations of claim 7 are not disclosed by and would not have been obvious based on Okuda, Aoki, Verhaverbeke, Tomita and Skee, even taken together in combination.

Claims 8, 10, 21, 22 and 27 depend from claim 7 and thus are patentably distinguishable over the cited art for at least the same reasons.

Rejection of Claims 11-14, 23, 24 and 28 under 35 U.S.C. § 103

Claims 11-14, 23, 24 and 28 are rejected under 35 U.S.C. § 103 as being obvious based on Aoki, Hall, U.S. Patent No. 4,326,553, Bran, U.S. Patent No. 6,039,059, as evidenced by Verhaverbeke, Tomita and Skee. Reconsideration of this rejection is respectfully requested.

According to an aspect of the invention, a substrate processing method comprising the three steps of: (i) supplying an alkaline solution to a surface of a substrate, (ii) supplying an acid solution to the surface of the substrate after the first step, and (iii) supplying the alkaline solution to the surface of the substrate after the second step, is provided such that the alkaline solution in the first and third steps comprise supplying the alkaline solution subjected to megasonic vibrations. According to an aspect of the invention, the alkaline solution subjected to megasonic vibrations is supplied to the surface of the substrate, and particles are removed from the surface as a result of the physical impact of the megasonic vibrations. In the second step, metal contaminant adhering to the surface are removed by the acid solution supplied. Further, since the substrate is slightly etched as a result of the second step, particles come up to the surface of the substrate by the etching and may be efficiently removed in the third step. As the alkaline solution subjected to megasonic vibrations in the third step is supplied to the surface of the substrate, particle and metal contaminants that have come up to the surface are removed by the

physical impact of the megasonic vibrations. Accordingly, the amount or degree of etching of the surface may be reduced or minimized and excessive impact to the surface may be avoided.

Claim 11 requires a first step of supplying an alkaline solution to a surface of a substrate, a second step of supplying an acid solution to the surface after the first step, and a third step of supplying the alkaline to the surface after the second step, the alkaline solution being subjected to megasonic vibrations, such that the alkaline solution is a mixed solution containing ammonia water and hydrogen peroxide water.

Aoki discloses a method and apparatus for cleaning electronic parts, including semiconductor substrates, including cleaning with either anolyte or catholyte electrolytic ionized water (EIW) produced from deionized water (Aoki, Abstract).

Aoki does not disclose or suggest the above-cited recitations of claim 11 performed in the order recited. Further, Aoki does not disclose or suggest that the alkaline solution is subjected to megasonic vibrations, as further required by claim 11. The remaining references cited, Hall, Bran, Verhaverbeke, Tomita and Skee, do not cure the above-discussed deficiencies of Aoki, because they do not disclose or suggest the above-cited recitations of claim 11. The particular operations recited in claim 7, in the order in which they are prescribed, produce the effects above-identified, and are not equivalent to a mere repetition of supplying an alkaline solution and supplying an acid solution. Accordingly, the recitations of claim 11 are not disclosed or suggested by the cited art, and would not have been obvious based on the cited art.

Further, it is respectfully submitted that even if Aoki were to describe using a combination of several cleaning solutions, a person of ordinary skill would have no motivation for selecting the combination of steps recited in claim 11. Many different combination of cleaning steps are possible, however, Aoki does not disclose or suggest the three major steps recited in claim 11. Accordingly, it is respectfully submitted that without resort to impermissible hindsight reconstruction based on applicant's own disclosure, the recitations of claim 11 would not have been obvious to a person of ordinary skill in the art based on Aoki and the remaining cited art.

Claims 12, 14, 23, 24 and 28 depend from claim 11 and are thus patentably distinguishable over the cited art for at least the same reasons.

Claim 13 is canceled and thus the rejection is moot with respect to this claim.

New Claims 29 and 30

New claims 29 and 30 are added. New claims 29 and 30 are fully supported by applicant's disclosure and introduce no impermissible new matter.

Claims 29 and 30 are patentably distinguishable over the cited art for at least the reason that they recite a substrate processing method including a first step of supplying an alkaline solution to a surface of a substrate, a second step of supplying an acid solution to the surface of the substrate after the first step, and a third step of supplying an alkaline solution to the surface of the substrate after the second step. In addition, claim 29 requires an injection of droplets formed by mixing the acid solution with gas, while claim 30 requires that the acid solution of the second step is subjected to megasonic vibrations.

Conclusion

In view of the foregoing discussion, withdrawal of the rejections and allowance of the application is respectfully requested. Should the Examiner have any questions regarding the present Amendment or regarding the application generally, the Examiner is invited to telephone the undersigned attorney at the below-provided telephone number.

Respectfully submitted,

THIS CORRESPONDENCE IS BEING
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ON NOVEMBER 16, 2006



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